Chapter 16A

Structural Design

Comparison Summary

The structural design chapters, Chapter 16 in the *IBC* and Chapter 35 of *NFPA 5000*, form basis for all structural design. This chapter sets forth loading and design criteria for the vertical and lateral force resisting systems. The format and presentation of the structural design chapters in the two model codes vary significantly. Both model codes rely on *ASCE 7-02* for much of the coverage of loads and forces on structures.

IBC 2003

Chapter 16 of the *IBC* is 93 pages long, and is divided into 23 sections. The chapter has been organized somewhat differently compared to the *CBC*, chiefly as a result of the adoption of portions of *ASCE 7-02* by reference. However, the format and order of presentation of the material will be familiar to individuals who use the *CBC*.

IBC sections governing dead and live loads, and combinations of loads will be familiar to *CBC* users, although some changes have been made. Significantly more extensive coverage of wind, snow and flood loads are provided, both in the *IBC* and through references to the corresponding sections of *ASCE 7-02*. California amendments covering partitions, location of vertical elements, distribution of horizontal shear, and stability against overturning were not incorporated into the *IBC*.

IBC contains both a simplified approach for wind design, as well as references to *ASCE 7-02* Section 6. This is a positive feature, since the wind design provisions of *ASCE 7-02* are significantly more complex than those found in the *CBC*. The precise relationship between the wind provisions in *IBC* Division III-Wind Design, and the simplified method in *ASCE 7-02* Section 6.4 is not clear, although the provisions appear compatible, and the *ASCE 7-02* Section 6.4 method is listed as an alternative method. The determination of importance factors for wind when using *ASCE 7-02* is somewhat unclear. Importance factors that are defined *ASCE 7-02* Table 6-1 differ from those in Table 1604.5 of *IBC*.

Seismic design can be performed using a number of different approaches. Designs in accordance with *ASCE 7-02*, Sections 9.1 through 9.6, 9.13 and 9.14 are permitted. Sections 9.7 through 9.12, which deal with foundations and structural materials, are not referenced. The appropriate chapters in the *IBC* are enforced instead. In this manner, a direct conflict with the *ASCE 7-02*, which references the 1999 edition material standards, is avoided. The *IBC* material chapters amend the 2002 edition material standards to provide compatibility with *ASCE 7-02*.

The *IBC* provides a simplified analysis approach for certain classes of structures in Seismic Use Group I. All other structures must use one of the analysis methods listed

in *ASCE 7-02* Section 9.2.5.1. Design of nonstructural components, nonbuilding structures, and base isolated structures, are governed by *ASCE 7-02*.

A number of detailed requirements for seismic design are included in Chapter 16, which supplement those found in *ASCE 7-02*. In general, it appears these provisions enhance the overall level of safety provided by the code.

NFPA 5000

In *NFPA 5000*, structural design is covered in the 8 ½ pages of Chapter 35. As with other structural chapters in *NFPA 5000*, heavy reliance is placed on referenced publications. A sizable portion of Chapter 35 simply transcribes portions of *ASCE 7-02*. Organization of the chapter is very different from that found in the *CBC*. References in Chapter 35 are especially troublesome, tending to be overbroad. For example, *NFPA 5000* Section 35.1.2.8.1.2 requires that drift limits applicable to earthquake loading shall be in accordance with Section 9 of *ASCE 7-02*. Given that Section 9 of *ASCE 7-02* is over 100 pages long, searching the chapter for references to drift is a sizable task. In contrast, the drift requirements of the *IBC* specify a specific section in *ASCE 7-02*.

Although organized differently, *NFPA 5000* sections governing dead and live loads, and combinations of loads will be familiar to CBC users. The wind, snow, and flood loads are all covered in detail in *ASCE 7-02*. Many California amendments, including those covering partitions, location of vertical elements, distribution of horizontal shear, and stability against overturning are not covered in the *NFPA 5000*. One drawback of the *NFPA 5000* code is the lack of simplified provisions for typical structures. For example, all structures, regardless of size or occupancy, must be designed using the complex wind provisions of *ASCE 7-02*.

Specific seismic provisions in *NFPA 5000* are virtually nonexistent, except for the general reference to *ASCE 7-02*.

Summary

IBC Chapter 16 covers structural design in considerably greater depth than *NFPA 5000* Chapter 35. By providing specific materials chapters within the code, rather than relying on the materials provisions of *ASCE 7-02*, *IBC* avoids the direct conflicts and potential safety issues inherent in adopting material standards different from those specified in *ASCE 7-02*.

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NFPA 5000 effectively amends *ASCE7-02* in a most profound way, by adopting and forcing the use of editions of material standards in *NFPA 5000* Chapters 41, 43, and 44, that differ from those specified in ASCE7-02. Without necessary amendments to correct deficiencies in these material standards, *NFPA 5000* creates significant coordination and safety issues. It must be noted that since the materials chapters in *NFPA 5000* specifically reference the 2002 editions of the material standards, Section 1.3.2 of *NFPA 5000* mandates their use – building in a host of conflicts and deficiencies.

At this time, the 2002 editions of the material standards are still under consideration for adoption into the 2003 NEHRP *Provisions* and *ASCE 7-05*. These documents are still being prepared at the national level. *IBC* adopts the 2002 editions of the materials

standards, but amends and coordinates them with other structural code provisions. By adopting the 2002 editions in advance of their consideration by the national standards, without coordinating and amending them, *NFPA 5000* has short-circuited the acceptance process.

Chapter 16A - Structural Design Requirements

2001 CBC	2003 IBC	Comments
Division I.GENERAL DESIGN REQUIREMENTS		
SECTION 1601A . SCOPE Section 1601A contains the scoping language for the chapter on Structural Design Requirements, indicating agencies responsible for different classifications of structures. It also contains references for existing buildings.	**1601Scope**. Single sentences stating that chapter 16 govern the structural design of buildings, structures, and portions thereof. ASCE 7, Section 9.1 General Provisions, contains general provisions as they pertain to seismic design.	Significant amendments required ASCE 7 contains requirements on alterations, additions, and change of use in Section 9.1 that are currently contained in non-structural chapters.
SECTION 1602A . DEFINITIONS Terms are defined for use in the code:	**1602 Definitions.** .	Significant additions to list
SECTION 1603A . NOTATIONS Some of the variables used in design are defined. However, variables are defined throughout the Sections of Chapter 16..	**1602 Definitions.** Notation included in Definitions section	
	Section 1603. Construction Documents	Requirements for construction documents. Corresponds to requirements in the Administrative Code. Amendments required.
SECTION 1604A . STANDARDS In this section, CBC recognizes three standards for wind design: ASCE 7, (for design loads for buildings and other structures) ANSI EIA/TIA 222-E, for steel antenna towers and antenna supporting structures ANSI/NAAMM FP1001, for flagpoles	**Chapter 35 Referenced Standards** Section includes all referenced standards in the code, including the code sections wherein the standard is referenced	Coordination required. IBC 2003 and ASCE 7 reference different editions of the same standards. However, IBC does not appear to adopt Section A.9 of ASCE 7, wherein the material standards are referenced.
SECTION 1605A . DESIGN **1605A.1 General**. General requirement that buildings and other structures and all portions thereof shall be designed and constructed to sustain the loads specified in the code. Specifies permissible design approaches (ASD and Strength). Permits "deemed to comply" conventional construction of light-frame structures.	**Section 1604 GENERAL DESIGN REQUIREMENTS** **1604.1 General** **1604.2 Strength**	Amendments required. Section does not cover alternative methods or construction procedures.
1605A.2 Rationality. Requirement for rational analysis.	**1604.4 Analysis**	Similar language
1605A.2.1 Distribution of horizontal shear. Distribution of lateral force to vertical elements. Consideration of Torsion.	No corresponding requirements in IBC 2003. ASCE 7 Section 9.5.5.5.2 covers torsion for seismic	Significant amendment required to cover distribution of lateral loads
1605A.2.2 Stability against overturning. General requirements. References Section 1611A.6 for retaining walls, Section 1615A for wind and Section 1626A for seismic.	No corresponding requirements in IBC 2003. Overturning for seismic is in ASCE 7 Section 9.5	Significant amendment required covering wind and soil retaining structures.
1605A.2.3 Anchorage. Anchorage of the roof to walls and columns, and of walls and columns to foundations. References sections 1632A, 1633A.2.8 and 1633A.2.9.	**1604.8**. Seismic requirements for anchorage of walls to roof also covered in ASCE 7. Requirements vary with SDC.	Significant amendment required.
1605A.3 Erection of Structural Framing. Walls and structural framing shall be erected true and plumb in accordance with the design.	No corresponding requirements in IBC 2003.	Amendment required.
1605A.4 Alternate Method. Acceptance and approval by the enforcement agency of design, materials or types of	Covered in part in Section 104.11. 1604.6 In-situ load test 1604.7 Preconstruction load tests	Amendment required.

2001 CBC	2003 IBC	Comments
construction other than those recognized in the regulations.		
1605A.5 Construction Procedures. Unusual erection or construction procedures.	No corresponding requirements in IBC 2003.	Amendment required.
SECTION 1606A . DEAD LOADS **1606A.1 General.** **1606A.2 Partition Loads.** Buildings where partition locations are subject to change use 20 pounds per square foot (psf) of floor area. Exception for access floors.	**1606 Dead Loads**. **1607.5 Permanent Partition Loads**. The actual weight of all permanent partitions shall be included	Amendment required to specify minimum partition load for seismic design.
SECTION 1607A . LIVE LOADS **1607A.1 General.**	**1607 Live Loads.** **1607.1 General**. **1607.2 Loads not Specified** **1607.3 Uniform live loads** **1607.4 Concentrated loads**	IBC references definition.
1607A.2 Critical Distribution of Live Loads.	**1607.1 Distribution of floor loads** **1607.11.1 Distribution of roof loads**	Similar requirements
1607A.3 Floor Live Loads. **1607A.3.1 General.** References Table 16A-A **1607A.3.2 Distribution of uniform floor loads** **1607A.3.3 Concentrated Loads** **1607A.3.4 Special Loads**	**1607.3 Uniform live loads** **1607.4 Concentrated loads** References Table 1607.1- **1607.7 Loads on handrails, guards, grab bars and vehicle barriers**	Arranged differently but similar provisions. Minor CA amendments
1607A.3.5 Live loads posted. *The live loads used in the design of floor and other areas shall be conspicuously posted* ***1607A.3.5.1 [For DSA-SS].*** *The owner or school board shall be responsible for keeping the actual load below the allowable limits.* ***1607A.3.5.2 [For OSHPD 1 & 4].*** *The hospital owner or hospital governing board shall be responsible for keeping the actual load below the allowable limits.*	No provisions in IBC 2003	Amendment required
1607A.4 Roof Live Loads. **1607A.4.1 General.** *The design dead loads shall provide for the weight of at least one reroofing in addition to other applicable loadings if the new roofing can be applied over the original roofing without its removal.*	**1607.11 Roof loads**	Amendment required for reroof
1607A.4.2 Distribution of loads. allows live loads on adjacent spans and on alternate spans. Special requirements for light-gage metal preformed structural sheets **1607A.4.3 Unbalanced loading.** Unbalanced loads shall be used where such loading will result in larger members or connections. Special requirements for trusses and arches	**1607.11.1** Permits use of alternate spans for capacity check. **1608.5** Distribution of snow loads on continuous span members	Amendment required for light-gage metal roofs and unbalanced loading
1607A.4.4 Special roof loads. Roofs to be used for special purposes shall be designed for appropriate loads as approved by the *enforcement agency*. *Uncovered open-frame roof structures shall be designed for a vertical live load of not less than 10 pounds per square foot (0.48 kN/m2) of the total area encompassed by the framework.*	**1607.11.2 Minimum roof live loads** **1607.11.2.1 Flat, pitched and curved roofs** **1607.11.2.2 Special-purpose roofs** **1607.11.2.3 Landscaped Roofs** **1607.11.2.4 Awnings and canopies.**	2003 IBC requirements more comprehensive

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2001 CBC	2003 IBC	Comments
1607A.5 Reduction of Live Loads.	**1607.9 Reduction in Live Loads**. Alternate method is the one currently adopted by OSHPD and DSA	Amendment may be required.
SECTION 1608A. SNOW LOADS References Chapter 16A, Division II.		
SECTION 1609A . WIND LOADS References Chapter 16A, Division III.		
SECTION 1610A . EARTHQUAKE LOADS References Chapter 16A, Division IV.		
SECTION 1611A . OTHER MINIMUM LOADS **1611A.1 General.**	**1605.3.1.2 Other Loads.**	Similar language
1611A.2 Other Loads. Buildings and other structures and portions thereof shall be designed to resist all loads due to applicable fluid pressures, *F,* lateral soil pressures, *H,* ponding loads, *P,* and self-straining forces, *T.* See Section 1611A.7 for ponding loads for roofs. **1611A.3 Impact Loads.** Impact loads shall be included in the design of any structure where impact loads occur.	**1607.12 Crane loads** **1607.8 Impact Loads.** **1607.6 Truck and bus garages**	2003 IBC requirements more comprehensive
1611A.4 Anchorage of Concrete and Masonry Walls.	**1604.8 Anchorage** Seismic requirements for anchorage of walls to roof covered in Chapter 9 ASCE 7. Requirements vary with SDC.	Relationship between 1604.8 and ASCE 7 is unclear
1611A.5 Interior Wall Loads. Interior walls, permanent partitions and temporary partitions	**1607.13 Interior Walls and Partitions**.	Amendment required. 2003 IBC does not include partition height or deflection criteria
1611A.6 Retaining Walls.. *Retaining walls higher than 12 feet shall be designed to resist the additional earth pressure caused by seismic ground shaking.* *The resultant of the vertical loads and lateral pressures acting on the wall and its base shall pass through the middle half of the bottom of the footing.* *Gravity walls require approval*	**Section 1806 Retaining Walls.**	Amendments required. IBC only notes FS=1.5 for sliding and overturning.
1611A.7 Water Accumulation. All roofs shall be designed with sufficient slope or camber to ensure adequate drainage. Ponding load shall include water accumulation from any source, including snow, due to deflection. Section 1506 and Table 16A-C, Footnote 3, for drainage slope. Section 1615A for deflection criteria.	**1604.3 Serviceability** Covers basic deflection criteria **Section 1611 Rain loads**	Amendments required
1611A.8 Hydrostatic Uplift. All foundations, slabs and other footings subjected to water pressure shall be designed to resist a uniformly distributed uplift load, *F,* equal to the full hydrostatic pressure.	No provisions in 2003 IBC	Amendments required
1611A.9 Flood-resistant Construction. For flood-resistant construction requirements, where specifically adopted, see Appendix Chapter 31, Division I.	**Section 1612 Flood Loads.** Extensive requirements	2003 IBC requirements much more comprehensive. However, some of the flood design provisions may be incompatible or in conflict with seismic

2001 CBC	2003 IBC	Comments
		design provisions.
1611A.10 Heliport and Helistop Landing Areas.	**1605.5 Heliports and Helistops**	Similar provisions
1611A.11 Prefabricated Construction. **1611A.11.1 Connections.** **1611A.11.2 Pipes and conduit.** **1611A.11.3 Tests and inspections.** ***1611A.12 Reviewing Stands, Grandstands and Bleachers.***	No requirements. (Blind reference in index).	Amendments required.
1611A.12.1 Portable bleachers. ***1611A.12.2 Portable folding indoor bleachers.*** *Portable folding indoor bleachers shall be designed and detailed to resist over-turning and sway in any direction in both the open and closed position when subjected to a lateral force of 0.30 times the dead load weight applied at the center of gravity.*	**1024.1.1** Footboards referred to ICC 300	Very little data. Amendments required.
1611A.13 Freestanding Cantilever Walls. *A stability check against the possibility of overturning shall be performed for isolated spread footings which support freestanding cantilever walls.*	No requirements	Amendments required
SECTION 1612A . COMBINATIONS OF LOADS **1612A.1 General.**	**Section 1605 Load Combinations.**	Similar general requirements
1612A.2 Load Combinations Using Strength Design or Load and Resistance Factor Design. **1612A.2.1 Basic load combinations.** **1612A.2.2 Other loads** **1612A.3 Load Combinations Using Allowable Stress Design.** **1612A.3.1 Basic load combinations.** **1612A.3.2 Alternate basic load combinations.**	**Section 1605 Load Combinations.** Also references Sections 2.3 and 2.4 of ASCE 7	Minor amendments may be required.
1612A.3.3 Other loads. **1612A.4 Special Seismic Load Combinations.**	**1605.3.2.1Other Loads** **1605.4 Special Seismic Load Combinations**	Similar provisions
SECTION 1613A . DEFLECTION ***1613A.1 General.***	**1604.3 Serviceability** **1604.3.1 Deflections**	Significant differences. Amendments required
1613A.2 Lateral Load Deflection. ***1613A.2.1 General.*** *The deflection of structural systems designed to resist wind or seismic loads shall be such that other portions of the structure are not overstressed.* ***NOTE:*** *See Section 1633A.2.4.*	**1604.3 Serviceability** Drift limits applicable to earthquake loading are referenced elsewhere in Chapter 16 and in ASCE & Section 9.	Amendment may be necessary
1613A.2.2 Vertical framing systems or elements. ***1613A.2.2.1 Deflection normal to plane of wall.*** *Exterior wall elements.* ***1613A.2.2.2 Story drift in plane of wall or vertical frame.*** *The lateral displacement of glazed openings.* ***1613A.2.2.3 Location of vertical lateral-force-resisting elements.*** *Limits on distance between vertical lateral force resisting elements*	No provisions in 2003 IBC	Extensive amendments required
1613A.2.3 Horizontal diaphragms. *The maximum span-width ratio for roof or floor diaphragms.*	No provisions in 2003 IBC	Amendment required
Division II.SNOW LOADS **SECTION 1614A . SNOW LOADS**	**Section 1608 Snow Loads.**	2003 IBC requirements much more comprehensive. Amendment required for

2001 CBC	2003 IBC	Comments
1614A.1 Snow Load Posting. *Snow loads used in design shall be posted as for live loads. See Section 1607A.3.5. Snow accumulation removal shall begin when the depth of snow creates loadings of 75 percent of the design values.*		posting
Division III.WIND DESIGN **SECTION 1615A . GENERAL** Structures sensitive to dynamic effects, such as *structures* with a height-to-width ratio greater than five, structures sensitive to wind-excited oscillations, such as vortex shedding or icing, and buildings over 400 feet (121.9m) in height, shall be, and any structure may be, designed in accordance with approved national standards. The provisions of this section do not apply to building and foundation systems in those areas subject to scour and water pressure by wind and wave action. Buildings and foundations subject to such loads shall be designed in accordance with approved national standards.	**Section 1609 Wind Loads.** References Section 6 of ASCE 7. Alternatives (1) Simplified procedure Section 1609.6 (restricted to smaller buildings) (2) Publication on hurricane restant residential constructin (3) Wood frame construction manual for one and two family dewellings (4) Flag poles (5) Antennas	2003 IBC/ASCE 7 requirements much more comprehensive.
SECTION 1616A . DEFINITIONS	**1609.2 Definitions**	Minor amendments required
SECTION 1617A . SYMBOLS AND NOTATIONS	**None**	
SECTION 1618A . BASIC WIND SPEED	**1609.3 Basic Wind Speed**.	Simplified procedure
SECTION 1619A . EXPOSURE *Exposure C is default requirement unless additional data provided*	**1609.4 Exposure Category.**	Simplified procedure. Amendment required.
SECTION 1620A . DESIGN WIND PRESSURES *Includes provisions story drift due to wind*	**1609.6.2.1 Main windforce-resisting system**. May also use ASCE 7 Section 6.4 (Simplified Procedure) or 6.5 (Analytical; Procedure)	Simplified procedure. Relationship with ASCE 7 Section 6.4 unclear. ASCE 7 requirements much more complex. Amendment required for drift
SECTION 1621A . PRIMARY FRAMES AND SYSTEMS	ASCE 7 Section 6.4 (Simplified Procedure) or 6.5 (Analytical; Procedure)	Simplified procedure. May also use ASCE 7 requirements, which are much more complex. Amendment required for uplift
SECTION 1622A . ELEMENTS AND COMPONENTS OF STRUCTURES	**1609.6.2.2 Components and cladding** ASCE 7 Section 6.4 (Simplified Procedure) or 6.5 (Analytical; Procedure)	Simplified procedure. May also use ASCE 7 requirements, which are much more complex.
SECTION 1623A . OPEN-FRAME TOWERS	ASCE 7 Section 6.5 (Analytical; Procedure)	ASCE 7 requirements much more complex.
SECTION 1624A . MISCELLANEOUS STRUCTURES	ASCE 7 Section 6.4 (Simplified Procedure) or 6.5 (Analytical; Procedure)	ASCE 7 requirements much more complex.
	1609.7 Roof systems	Wind requirements for roof systems. Not covered in 2001 CBC
SECTION 1625A . OCCUPANCY CATEGORIES	1604.5 Importance factors	Relationship with ASCE 7 Section 6.5.5 and Section 9.1.4 unclear.
Division IV.EARTHQUAKE DESIGN **SECTION 1626A . GENERAL** **1626A.2 Minimum Seismic Design.** **1626A.3 Seismic and Wind Design.** ***1626A.4 [For OSHPD 1 & 4] Configuration***	**Section 1614 EARTHQUAKE LOADS - GENERAL** Section 9 of ASCE 7.	Amendments required for minimum seismic design, configuration, additions and alterations. Permits designs in accordance with Section 9.1 through 9.6.9.13 and Section 9.14 of ASCE 7.
SECTION 1627A . DEFINITIONS	**Section 1613 EARTHQUAKE LOADS DEFINITIONS** ASCE 7 Section 9.2	Extensive amendments required to cover additions, repairs and alterations
SECTION 1628A . SYMBOLS AND NOTATIONS	ASCE 7 Section 9.2.2	No separate notation section in 2003 IBC
SECTION 1629A . CRITERIA SELECTION **1629A.1 Basis for Design.**	**Section 1619 EARTHQUAKE LOADS – CRITERIA SELECTION** Section 1616.1 Structural design criteria ASCE 7 Section 9.1	
1629A.2 Occupancy Categories.	1616.2 Seismic use groups and	Fundamental change in approach.

Chapter 16A - Structural Design Requirements

2001 CBC	2003 IBC	Comments
	occupancy importance factors ASCE 7 Section 9.1	Seismic design requirements now based on Seismic Design Category (SDC) that is a function of occupancy and seismic risk. Extensive amendments required. 2003 IBC and ASCE 7 permit widespread use of very low ductility lateral force resisting systems. 2003 IBC permits determination of SDC based only on the short period motion.
1629A.3 Site Geology and Soil Characteristics. **1629A.4 Site Seismic Hazard Characteristics.** **1629A.4.1 Seismic zone.** **1629A.4.2 Seismic Zone 4 near-source factor** **1629A.4.3 Seismic response coefficients.**.	**Section 1615 EARTHQUAKE LOADS-SITE GROUND MOTION** ASCE 7 Section 9.4.1.2.2, 9.4.1.2.3 ASCE 7 Section 9.4.1.2.1 ASCE 7 Section 9.4.1.2.4	Zone maps have been replaced by contour maps. Seismic demand is different. There are no near source factors
1629A.5 Configuration Requirements. **1629A.5.1 General** **1629A.5.2 Regular structures.** **1629A.5.3 Irregular structures.**	1616.5 Building configuration ASCE 7 Section 9.5.2.3	2003 IBC requires use of ASCE 7 to determine configuration, unless simplified design procedure is used. Similar provisions to 2001 CBC. Some amendments required
1629A.6 Structural Systems. **1629A.6.1 General.** **1629A.6.2 Bearing wall system.** **1629A.6.3 Building frame system.** **1629A.6.4 Moment-resisting frame system.** **1629A.6.5 Dual system.** **1629A.6.6 Cantilevered column system.** **1629A.6.7 Undefined structural system**. **1629A.6.8 Nonbuilding structural system.** **1629A.7 Height Limits**	Section 1617.6 Seismic force-resisting systems ASCE 7 Section 9.5.2.1 ASCE 7 Section 9.5.2.2	Extensive amendments required. Series of specific requirements and references to ASCE 7. Permits widespread use of very low ductility lateral force resisting systems.
1629A.8 Selection of Lateral-force Procedure. **1629A.8.1 General.** **1629A.8.2 Simplified static.** *[Not adopted by OSHPD.]* **1629A.8.3 Static.** **1629A.8.4 Dynamic.**	1616.6 Analysis procedures ASCE 7 Section 9.5.2.5 ASCE 7 Section 9.5.2.5.1	Extensive amendments required. Contains specific language as well as references to ASCE 7. Permits index and simplified lateral force design procedures. ASCE 7 permits 6 analytical methods: 1. Index force analysis 2. Simplified analysis 3. Equivalent lateral force analysis 4. Modal response spectrum analysis 5. Linear response history analysis 6. Nonlinear response history analysis
1629A.9 System Limitations **1629A.9.1 Discontinuity**	1617.6.2.4 Seismic limitation or Seismic Design Category D, E, or F ASCE 7 Section 9.5.2.6.2.4	
1629A.9.2 Undefined structural systems	ASCE 7 Section 9.5.2.2	Amendment required
1629A.9.3 Irregular features	ASCE 7 Section 9.5.2.3	Significant amendments required
SECTION 1630A . MINIMUM DESIGN LATERAL FORCES AND RELATED EFFECTS **1630A.1 Earthquake Loads and Modeling Requirements.** **1630A.1.1 Earthquake loads.** Redundancy Factor Seismic dead load	**Section 1617 EARTHQUAKE LOADS – MINIMUM DESIGN LATERAL FORCE AND RELATED EFFECTS** ASCE 7 Section 9.5.2.5 1617.2 Redundancy ASCE 7 Section 9.5.2.7.1 ASCE 7 Section 9.5.2.4 ASCE 7 Section 9.5.3	Amendments required. 2003 IBC and ASCE 7 links design and detailing requirements to SDC rather than importance or occupancy. Many references to portions of ASCE 7 Weight definition must be moved out of the index force provisions. Amendment for unbalanced soil loads required.
1630A.1.2 Modeling requirements.	No direct requirements in 2003 IBC ASCE 7 Section 9.5.3 through 9.5.8	Extensive amendments required. Modeling requirements vary depending on

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2001 CBC	2003 IBC	Comments
1630A.1.3 *PΔ*. effects. **1630A.2 Static Force Procedure.** **1630A.2.1 Design base shear.** **1630A.2.2 Structure period.** **1630A.2.3 Simplified design base shear.** *[Not adopted by OSHPD]* **1630A.2.3.1 General.** **1630A.2.3.2 Base shear.** **1630A.2.3.3 Vertical distribution.**. **1630A.2.3.4 Applicability.**	ASCE 7 Section 9.5.5.7 1617.4 Equivalent lateral force procedure for seismic design ASCE 7 Section 9.5.5 ASCE 7 Section 9.5.5.2 ASCE 7 Section 9.5.5.3 ASCE 7 Section 9.5.4 1617.5 Simplified analysis procedure for seismic design of buildings	the analysis procedure chosen. Many references to ASCE 7. Amendments required Not adopted by OSHPD
1630A.3 Determination of Seismic Factors. **1630A.3.1 Determination of Ω*o*.** **1630A.3.2 Determination of *R*.**	1617.6 Seismic force resisting systems ASCE 7 Section 9.5.2.2	Extensive amendments required. 2003 IBC and ASCE 7 permits widespread use of very low ductility lateral force resisting systems.
1630A.4 Combinations of Structural Systems. **1630A.4.1 General.** **1630A.4.2 Vertical combinations.** **1630A.4.3 Combinations along different axes.** **1630A.4.4 Combinations along the same axis.**	1617.6.2 (simplified method only) ASCE 7 Section 9.5.2.2	Amendments required. Interrelationship between ASCE 7 and 2003 IBC is confusing
1630A.5 Vertical Distribution of Force.. **1630A.7 Horizontal Torsional Moments.**	1617.5.2 Vertical distribution ASCE 7 Section 9.5.5.4 1620.4.1 ASCE 7 Section 9.5.5.	Requirements in both ASCE 7 and 2003 IBC. Amendments required
1630A.8 Overturning. **1630A.8.1 General.**	ASCE 7 Section 9.5.5.6	Requirements are in ASCE 7. Amendments required
1630A.8.2 Elements supporting discontinuous systems. **1630A.8.2.1 General** **1630A.8.2.2 Detailing requirements in Seismic Zones 3 and 4**	1620.1 Structural component design and detailing, 1620.2.3 (simplified design) 1620.2.9 (simplified design) ASCE 7 Section 9.5.2.6.2.11 ASCE 7 Section 9.5.2.6.4.2 ASCE 7 Section 9.5.2.6.5.1	Amendments required. Varies with SDC Relationship between 2003 IBC provisions and ASCE 7 unclear.
1630A.8.3 At foundation.	No requirements	Amendment required
1630A.9 Drift.	1617.3 Deflection and drift limits ASCE 7 Section 9.5.2.8 ASCE 7 Section 9.5.5.7	Varies with analysis method. References to ASCE 7.
1630A.9.1 Determination of Δ*S*.	ASCE 7 Section 9.5.5.7.1	
1630A.9.2 Determination of Δ*M*	ASCE 7 Section 9.5.5.7.1 ASCE 7 Section 9.5.6.6	
1630A.10 Story Drift Limitation.	ASCE 7 Section 9.5.2.8 ASCE 7 Section 9.5.4.4 ASCE 7 Section 9.5.6.6 ASCE 7 Section 9.5.8.3	Amendment required. Permissible drifts depend on analysis method
1630A.10.1 General.	ASCE 7 Section 9.5.5.7	
1630A.10.2 Calculated.		
1630A.10.3 Limitations.		
1630A.11 Vertical Component.	1620.4.2 Vertical seismic forces ASCE 7 Section 9.5.2.6.4.3	Amendment required
SECTION 1631A . DYNAMIC ANALYSIS PROCEDURES **1631A.1 General.**	**Section 1618 DYNAMIC ANALYSIS PROCEDURE FOR THE SEISMIC DESIGN OF BUILDNGS** ASCE 7 Section 9.5.6	References ASCE 7. Dynamic procedures cover only the modal analysis. Other requirements (ground motion, detail requirements) not tied to procedure
1631A.2 Ground Motion.	ASCE 7 Section 9.4.1.2.6	May require amendment
1631A.3 Mathematical Model.	**Section 1619 EARTHQUAKE LOADS, SOIL-STRUCTURE INTERACTION** ASCE 7 Section 9.5.9 ASCE 7 Section 9.5.6.2	May require amendment

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1631A.4 Description of Analysis Procedures.		
1631A.4.1 Response spectrum analysis.		
1631A.4.2 Time-history analysis.	ASCE 7 9.5.8	Amendment required. ASCE 7 permits nonlinear response history analysis
1631A.5 Response Spectrum Analysis.	ASCE 7 Section 9.5.6	
1631A.5.1 Response spectrum representation and interpretation of results.	ASCE 7 Section 9.5.6. ASCE 7 Section 9.5.6.7	
1631A.5.2 Number of modes.	ASCE 7 Section 9.5.6.3	
1631A.5.3 Combining modes.	ASCE 7 Section 9.5.6.6	
1631A.5.4 Reduction of Elastic Response Parameters for design.	ASCE 7 Section 9.5.6.5	Amendment may be required
1631A.5.5 Directional effects.	ASCE 7 Section 9.5.2.5.2 ASCE 7 Section 9.5.2.6.2.4	Amendment may be required. Requirements vary with SDC
1631A.5.6 Torsion.	ASCE 7 Section 9.5.5.4	Amendment may be required
1631A.5.7 Dual systems.	ASCE 7 Section 9.5.2.2.1	Amendment required
1631A.6 Time-history Analysis. **1632A.1 General.**	ASCE 7 Section 9.5.7	Detailed review needed
1631A.6.1 Time history.	ASCE 7 Section 9.5.7.2	
1631A.6.2 Elastic time-history analysis.	ASCE 7 Section 9.5.7.2 ASCE 7 Section 9.5.7.3	
1631A.6.3 Nonlinear time-history analysis.	ASCE 7 Section 9.5.8	Extensive review needed. Amendments likely to be required
1631A.6.3.1 Nonlinear time history.	ASCE 7 Section 9.5.8	
1631A.6.3.2 Design review. *[Not adopted by OSHPD]*	ASCE 7 Section 9.5.8.4	Amendment required
SECTION 1632A . LATERAL FORCE ON ELEMENTS OF STRUCTURES, NONSTRUCTURAL COMPONENTS AND EQUIPMENT SUPPORTED BY STRUCTURES	**Section 1621 ARCHITECTURAL, MECHANICAL AND ELECTRICAL COMPONENT SEISMIC DESIGN REQUIREMENTS** ASCE 7 Section 9.6	Reference to ASCE 7 with modifications for sprinklers, partitions, and mechanical equipment. Significantly more detail in ASCE 7. Extensive coverage of architectural elements including glazing and curtain walls. Significant amendments required for OSHPD performance objectives, especially for sprinklers
1632A.1 General.	ASCE 7 Section 9.6.1	
1632A.2 Design for Total Lateral Force.	ASCE 7 Section 9.6.1.3	
1632A.3 Specifying Lateral Forces.	ASCE 7 Section 9.6.1	
1632A.4 Relative Motion of Equipment Attachments.	ASCE 7 Section 9.6.1.4	
1632A.5 Alternative Designs.	ASCE 7 Section 9.6.3.15	Some amendments required
1632A.6 HVAC Ductwork, Plumbing/Piping and Conduit Systems.	ASCE 7 Section 9.6.3	Some amendments required
SECTION 1633A . DETAILED SYSTEMS DESIGN REQUIREMENTS **1633A.1 General.**	**Section 1650 EARTHQUAKE LOADS-DESIGN DETAILING REQUIREMENTS AND STRUCTURAL COMPONENT LOAD EFFECTS** ASCE 7 Section 9.5.2.2.4.3 ASCE 7 Section 9.5.2.6	References ASCE 7. Requirements based on SDC. Amendment required
1633A.2 Structural Framing Systems. **1633A.2.1 General.**	ASCE 7 Section 9.5.2.2	Amendments required
1633A.2.2 Detailing for combinations of systems.	ASCE 7 Section 9.5.2.2.2	Amendments required
1633A.2.3 Connections		Amendments required
1633A.2.4 Deformation compatibility.	ASCE 7 Section 9.5.2.2.4.3	
1633A.2.4.1 Adjoining rigid elements.	ASCE 7 Section 9.5.2.2.4.2	
1633A.2.4.2 Exterior elements.	ASCE 7 Section 9.6.2.4	
1633A.2.5 Ties and continuity.	ASCE 7 Section 9.5.2.6.1.1	Amendments required. Varies with SDC
1633A.2.6 Collector elements.	Section 1620.2.6 Collector elements ASCE 7 Section 9.5.2.6.2.6	Amendments required. Varies with SDC

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	ASCE 7 Section 9.5.2.6.3.1 ASCE 7 Section 9.5.2.6.4.1	
1633A.2.7 Concrete frames.	ASCE 7 Table 9.5.2.2	Amendments required. Varies with SDC
1633A.2.8 Anchorage of concrete or masonry walls.	1620.3.1 Anchorage of concrete or masonry walls ASCE 7 Section 9.5.2.6.1.2 ASCE 7 Section 9.5.2.6.2.8 ASCE 7 Section 9.5.2.6.3.2	Amendments required. Varies with SDC
1633A.2.8.1 Out-of-plane wall anchorage to flexible diaphragms	1620.4.6 Anchorage of concrete or masonry walls to flexible diaphragms ASCE 7 Section 9.5.2.6.3.2	Amendments required. Varies with SDC
1633A.2.9 Diaphragms.	Section 1620.5 Diaphragms ASCE 7 Section 9.5.2.6.2.7 ASCE 7 Section 9.5.2.6.4.4	Amendments required. Varies with SDC
1633A.2.10 Framing below the base.	ASCE 7 Section 9.5.7	Amendments required
1633A.2.11 Building separations.	1620.4.5 Building Separations ASCE 7 Section 9.5.2.8	Amendments required
1633A.2.12 Foundations and superstructure-to-foundation connections.	ASCE 7 Section 9.5.7	Amendments required. Varies with SDC
1633A.2.13 Requirements for elevators.	ASCE 7 Section 9.6.3.16	Amendments required
SECTION 1634A . NONBUILDING STRUCTURES	**Section 1622 NONBUILDING STRUCTURES SEISMIC DESIGN REQUIREMENTS** ASCE 7 Section 9.14	References ASCE 7. Some modifications. ASCE 7 provisions far more extensive. Detailed review and some amendments required
SECTION 1635A . EARTHQUAKE-RECORDING INSTRUMENTATIONS		Amendments required
Division V. SOIL PROFILE TYPES SECTION 1636A . SITE CATEGORIZATION PROCEDURE	**Section 1615 EARTHQUAKE LOADS – SITE GROUND MOTION** ASCE 7 Section 9.4.1.2	New methodology
1636A.1 Scope.	ASCE 7 Section 9.4.1.2	
1636A.2 Definitions	ASCE 7 Section 9.4.1.2.1	
1636A.2.1 Average shear wave velocity.	ASCE 7 Section 9.4.1.2.2.2	
1636A.2.2 average field standard penetration resistance and average standard penetration resistance for cohesionless soil layers.	ASCE 7 Section 9.4.1.2.3	
1636A.2.3 Average undrained shear strength.	ASCE 7 Section 9.4.1.2.3	
1636A.2.4 Soft clay profile,	ASCE 7 Section 9.4.1.2.2	
1636A.2.5 Soil profiles	ASCE 7 Section 9.4.1.2.2	
1636A.2.6 Rock profiles	ASCE 7 Section 9.4.1.2.2	
SECTION 1637A . SITE DATA FOR STATE-OWNED OR STATE-LEASED ESSENTIAL SERVICES		Amendments required
SECTION 1638A [FOR OSHPD 1 & 4] . ADDITIONS, ALTERATIONS, REPAIRS AND SEISMIC RETROFIT TO EXISTING BUILDINGS OR STRUCTURES	**Chapter 34**	Extensive amendments required. To conform with statutory and regulatory requirements
Division VI-R .EARTHQUAKE EVALUATION AND DESIGN FOR RETROFIT OF [FOR BSC, DSA] EXISTING STATE-OWNED BUILDINGS [FOR OSHPD] EXISTING HOSPITAL BUILDINGS		No corresponding provisions.

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Division I.GENERAL DESIGN REQUIREMENTS		
SECTION 1601A . SCOPE Section 1601A contains the scoping language for the chapter on Structural Design Requirements, indicating agencies responsible for different classifications of structures. It also contains references for existing buildings.	**35.1 General.** **35.1.1 Scope.** Single sentences stating that chapter 35 govern the structural design of buildings, structures, and portions thereof. ASCE 7, Section 9.1 General Provisions, contains general provisions as they pertain to seismic design.	Significant amendments required ASCE 7 contains requirements on alterations, additions, and change of use in Section 9.1 that are currently contained in non-structural chapters.
SECTION 1602A . DEFINITIONS Terms are defined for use in the code:	**35.2 Definitions.** Definitions are extracted from ASCE 7. There are no definitions unique to NFPA 5000.	In CBC Chapter 16, the definitions are defined in the portions of the code (Wind, Seismic, etc.) where they are used. In NFPA 5000, some (but not all) of the definitions in ASCE 7 are reproduced in Section 35.2.
SECTION 1603A . NOTATIONS Some of the variables used in design are defined. However, variables are defined throughout the Sections of Chapter 16..	Some notation defined in different Sections of Chapter 35. ASCE 7 Section 9.2.2 summarizes all notation used in ASCE 7. Notation is also defined (redefined) in sections of the various chapters of ASCE 7.	Significant coordination required. NFPA 5000, ASCE 7 Section 9.2.2, and the Chapters of ASCE 7 all define notation. In many cases, the same variable has multiple definitions.
SECTION 1604A . STANDARDS In this section, CBC recognizes three standards for wind design: ASCE 7, (for design loads for buildings and other structures) ANSI EIA/TIA 222-E, for steel antenna towers and antenna supporting structures ANSI/NAAMM FP1001, for flagpoles	NFPA 5000 references an extensive list of standards. ASCE 7 also references an extensive list of standards	Major coordination required. NFPA 5000 and ASCE 7 reference different editions of the same standards. It will be necessary to extensively review and amend the documents to make them compatible
SECTION 1605A . DESIGN **1605A.1 General**. General requirement that buildings and other structures and all portions thereof shall be designed and constructed to sustain the loads specified in the code. Specifies permissible design approaches (ASD and Strength). Permits "deemed to comply" conventional construction of light-frame structures.	**35.1.2* Structural Design**. General design requirements/ **35.1.2.1 Design Methods**. ASD or strength **35.1.2.2 Basic Requirements**. Must meet Section 1.3 of ASCE 7,	Major amendments required. There are no conventional construction provisions for light frame structures in NFPA 5000 or ASCE 7. NFPA 5000 Section 35.1.2.3 lists reference documents for one and two family dwellings. The application of these references is unclear, since some only cover portions of the structure.
1605A.2 Rationality. Requirement for rational analysis.	**35.1.2.4 General Structural Integrity**. Reference to Section 1.4 of ASCE 7. **35.1.2.5 Load Path.** Load path required.	Similar language
1605A.2.1 Distribution of horizontal shear. Distribution of lateral force to vertical elements. Consideration of Torsion.	ASCE 7 Section 9.5.5.5.2 covers torsion for seismic	Significant amendment required to cover distribution of lateral loads
1605A.2.2 Stability against overturning. General requirements. References Section 1611A.6 for retaining walls, Section 1615A for wind and Section 1626A for seismic.	No corresponding requirements in NFPA 5000. Overturning for seismic is in ASCE 7 Section 9.5	Significant amendment required covering wind and soil retaining structures.
1605A.2.3 Anchorage. Anchorage of the roof to walls and columns, and of walls and columns to foundations. References sections 1632A, 1633A.2.8 and 1633A.2.9.	No corresponding requirements in NFPA 5000. Seismic requirements for anchorage of walls to roof covered in ASCE 7. Requirements vary with SDC.	Significant amendment required.
1605A.3 Erection of Structural Framing. Walls and structural framing shall be erected true and plumb in accordance with the design.	No corresponding requirements in NFPA 5000.	Amendment required.

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1605A.4 Alternate Method. Acceptance and approval by the enforcement agency of design, materials or types of construction other than those recognized in the regulations.	Covered in part in NFPA Section 1.5.	Amendment required.
1605A.5 Construction Procedures. Unusual erection or construction procedures.	No corresponding requirements in NFPA 5000.	Amendment required.
SECTION 1606A . DEAD LOADS **1606A.1 General.** **1606A.2 Partition Loads.** Buildings where partition locations are subject to change use 20 pounds per square foot (psf) of floor area. Exception for access floors.	**35.5 Dead Loads**. **35.5.3 Permanent Partition Loads**. The actual weight of all permanent partitions shall be included **35.6.2.3.1.1** In buildings where partitions will be erected or rearranged, provision for partition weight shall be made – no minimum load **35.6.2.3.1.2** Not required where the specified live load exceeds 80 psf (3.83 kN/m2).	Amendment required to specify minimum partition load..
SECTION 1607A . LIVE LOADS **1607A.1 General.**	**35.6 Live Loads.** **35.6.1 General**.	Nearly identical
1607A.2 Critical Distribution of Live Loads.	**35.6.1.4**	Similar requirements
1607A.3 Floor Live Loads. **1607A.3.1 General.** References Table 16A-A **1607A.3.2 Distribution of uniform floor loads** **1607A.3.3 Concentrated Loads** **1607A.3.4 Special Loads**	**35.6.1.2 - 35.6.4** This section references ASCE 7 Table 4-	Arranged differently but similar provisions. Minor CA amendments
1607A.3.5 Live loads posted. *The live loads used in the design of floor and other areas shall be conspicuously posted* ***1607A.3.5.1 [For DSA-SS].*** *The owner or school board shall be responsible for keeping the actual load below the allowable limits.* ***1607A.3.5.2 [For OSHPD 1 & 4].*** *The hospital owner or hospital governing board shall be responsible for keeping the actual load below the allowable limits.*	No provisions in NFPA 5000	Amendment required
1607A.4 Roof Live Loads. **1607A.4.1 General.** *The design dead loads shall provide for the weight of at least one reroofing in addition to other applicable loadings if the new roofing can be applied over the original roofing without its removal.*	No provisions in NFPA 5000	Amendment required
1607A.4.2 Distribution of loads. allows live loads on adjacent spans and on alternate spans. Special requirements for light-gage metal preformed structural sheets **1607A.4.3 Unbalanced loading.** Unbalanced loads shall be used where such loading will result in larger members or connections. Special requirements for trusses and arches	**35.7.1.2.1** Permits use of alternate spans for capacity check. **35.7.1.2.2** Distribution of snow loads on continuous span members shall be in accordance with 35.8.5.	Amendment required for light-gage metal roofs and unbalanced loading
1607A.4.4 Special roof loads. Roofs to be used for special purposes shall be	**35.7.4 Special-Purpose Roofs.** Where occupied for incidental promenade	NFPA 5000 requirements more comprehensive

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designed for appropriate loads as approved by the *enforcement agency*. *Uncovered open-frame roof structures shall be designed for a vertical live load of not less than 10 pounds per square foot (0.48 kN/m2) of the total area encompassed by the framework.*	purposes, roofs shall be designed for a minimum live load of 60 psf (2.87 kN/m2) and 100 psf (4.79 kN/m2) where designed for roof gardens or assembly or educational occupancies. **35.7.4.1** Landscaped roofs. **35.7.4.2** Where awnings and canopies **35.7.4.3** Roofs to be utilized for other special purposes. 35.7.3 Rain Loads. 35.7.3.1 Ponding instability Section 8.4 of ASCE 7. 35.7.3.2 Controlled drainage Section 8.5 of ASCE 7. 35.7.3.3 Rain loading shall also comply with Section 38.11.	
1607A.5 Reduction of Live Loads.	**35.6.7 Reduction in Live Loads**. References Section 4.8 of ASCE 7.	Amendment may be required. Uses a reduction method currently not adopted by DSA/OSHPD
SECTION 1608A. SNOW LOADS References Chapter 16A, Division II.		
SECTION 1609A . WIND LOADS References Chapter 16A, Division III.		
SECTION 1610A . EARTHQUAKE LOADS References Chapter 16A, Division IV.		
SECTION 1611A . OTHER MINIMUM LOADS **1611A.1 General.**	**35.14 Other Minimum Loads.** **35.14.1 General.**	Similar language
1611A.2 Other Loads. Buildings and other structures and portions thereof shall be designed to resist all loads due to applicable fluid pressures, *F,* lateral soil pressures, *H,* ponding loads, *P,* and self-straining forces, *T.* See Section 1611A.7 for ponding loads for roofs. **1611A.3 Impact Loads.** Impact loads shall be included in the design of any structure where impact loads occur.	**35.4.2.6 Other Loads.** **35.4.2.6.1** Special Loads.. **35.6.6*** Impact Loads. Section 4.7 of ASCE 7. **35.6.8** Crane Loads. Section 4.10 in ASCE 7. **35.13 Ice Loads** —Section 10 of ASCE 7**.**	NFPA 5000 requirements more comprehensive
1611A.4 Anchorage of Concrete and Masonry Walls.	Seismic requirements for anchorage of walls to roof covered in Chapter 9 ASCE 7. Requirements vary with SDC.	
1611A.5 Interior Wall Loads. Interior walls, permanent partitions and temporary partitions	**35.6.9 Interior Walls and Partitions**.	Amendment required. NFPA 5000 does not include partition height or deflection criteria
1611A.6 Retaining Walls.. *Retaining walls higher than 12 feet shall be designed to resist the additional earth pressure caused by seismic ground shaking.* Retaining walls shall be designed with a factor of safety of 1.5 for sliding and overturning *The resultant of the vertical loads and lateral pressures acting on the wall and its base shall pass through the middle half of the bottom of the footing.* *Gravity walls require approval*	**35.11 Lateral Soil Loads.** In absence of a geotechnical soil analysis, soil loads in Table 35.11 shall be used as the minimum design lateral soil loads. **Table 35.11 Soil Lateral Load** Additional prescriptive soil loading in this table. Values are less conservative than ASCE 7, Table 5-1.	Extensive amendments required
1611A.7 Water Accumulation. All roofs shall be designed with sufficient slope or camber to ensure adequate drainage. Ponding load shall include water	**35.1.2.8.8* Roof Deflection.** All roofs shall be designed with a slope or camber to allow drainage after the dead load deflection.	Similar provisions

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accumulation from any source, including snow, due to deflection. Section 1506 and Table 16A-C, Footnote 3, for drainage slope. Section 1615A for deflection criteria.		
1611A.8 Hydrostatic Uplift. All foundations, slabs and other footings subjected to water pressure shall be designed to resist a uniformly distributed uplift load, *F,* equal to the full hydrostatic pressure.	**35.14.2 Hydrostatic Uplift.** Loads shall be determined in accordance with Section 5.2 of ASCE 7.	Similar provisions
1611A.9 Flood-resistant Construction. For flood-resistant construction requirements, where specifically adopted, see Appendix Chapter 31, Division I.	**35.4.2.6.2 Flood Loads.** Extensive requirements. Entire Chapter 39 covers flood loads.	NFPA 5000 requirements much more comprehensive. However, some of the flood design provisions may be incompatible or in conflict with seismic design provisions.
1611A.10 Heliport and Helistop Landing Areas.	**35.14.3 Heliport and Helistop Landing Areas.**	Similar provisions
1611A.11 Prefabricated Construction. **1611A.11.1 Connections.** **1611A.11.2 Pipes and conduit.** **1611A.11.3 Tests and inspections.** ***1611A.12 Reviewing Stands, Grandstands and Bleachers.***	No requirements. (Blind reference in index).	Amendments required.
1611A.12.1 Portable bleachers. ***1611A.12.2 Portable folding indoor bleachers.*** *Portable folding indoor bleachers shall be designed and detailed to resist over-turning and sway in any direction in both the open and closed position when subjected to a lateral force of 0.30 times the dead load weight applied at the center of gravity.*	**35.6.2.3.2** Footboards in reviewing stands, grandstands, and bleachers shall be designed to resist 120 lb/linear ft (180 kg/linear m). **35.6.2.3.3** Reviewing stands, grandstands, bleachers, and supporting structures shall meet the requirements of 35.6.2.3.3.1 and 35.6.2.3.3.2.	Different loading. Amendments may be required.
1611A.13 Freestanding Cantilever Walls. *A stability check against the possibility of overturning shall be performed for isolated spread footings which support freestanding cantilever walls.*	No requirements	Amendments required
SECTION 1612A . COMBINATIONS OF LOADS **1612A.1 General.**	**35.15 Load Combinations.**	Similar general requirements
1612A.2 Load Combinations Using Strength Design or Load and Resistance Factor Design. **1612A.2.1 Basic load combinations.** **1612A.2.2 Other loads** **1612A.3 Load Combinations Using Allowable Stress Design.** **1612A.3.1 Basic load combinations.** **1612A.3.2 Alternate basic load combinations.**	**35.15** References Sections 2.3 and 2.4 of ASCE 7	Minor amendments may be required.
1612A.3.3 Other loads. **1612A.4 Special Seismic Load Combinations.**	**35.15 Other Loads** **ASCE 7, Section 9.5.2.7.1**	Similar provisions
SECTION 1613A . DEFLECTION ***1613A.1 General***.	**35.1.2.8 Deflections.** **35.1.2.8.1 General.**	Significant differences. Amendments required
1613A.2 Lateral Load Deflection. ***1613A.2.1 General.*** *The deflection of*	**35.1.2.8.1.2** Drift limits applicable to earthquake loading shall be in accordance	Amendment may not be necessary

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structural systems designed to resist wind or seismic loads shall be such that other portions of the structure are not overstressed. ***NOTE:*** *See Section 1633A.2.4.*	with Section 9 of ASCE 7.	
1613A.2.2 Vertical framing systems or elements. ***1613A.2.2.1 Deflection normal to plane of wall.*** *Exterior wall elements.* ***1613A.2.2.2 Story drift in plane of wall or vertical frame.*** *The lateral displacement of glazed openings.* ***1613A.2.2.3 Location of vertical lateral-force-resisting elements****.* *Limits on distance between vertical lateral force resisting elements*	No provisions in NFPA 5000 **35.1.2.8.6 Glazing**. Glazing supports shall comply with Section 46.9. No provisions in NFPA 5000	Extensive amendments required
1613A.2.3 Horizontal diaphragms. *The maximum span-width ratio for roof or floor diaphragms.*	No provisions in NFPA 5000	Amendment required
Division II.SNOW LOADS **SECTION 1614A . SNOW LOADS** ***1614A.1 Snow Load Posting.*** *Snow loads used in design shall be posted as for live loads. See Section 1607A.3.5. Snow accumulation removal shall begin when the depth of snow creates loadings of 75 percent of the design values.*	**35.8 Snow Loads.** **35.8.1 General.** **ASCE 7. Chapter 7**	NFPA 5000 requirements much more comprehensive. Amendment required for posting
Division III.WIND DESIGN **SECTION 1615A . GENERAL** Structures sensitive to dynamic effects, such as *structures* with a height-to-width ratio greater than five, structures sensitive to wind-excited oscillations, such as vortex shedding or icing, and buildings over 400 feet (121.9m) in height, shall be, and any structure may be, designed in accordance with approved national standards. The provisions of this section do not apply to building and foundation systems in those areas subject to scour and water pressure by wind and wave action. Buildings and foundations subject to such loads shall be designed in accordance with approved national standards.	**35.9 Wind Loads.** References Section 6 of ASCE 7. Alternatives (1) ANSI/NAAMM FP 1001, Guide Specifications for Design of Metal Flagpoles Manual (2) Wind tunnel tests conducted in accordance with Section 6.6 of ASCE 7 (3) ANSI/TIA/EIA-222-F, Structural Standards for Steel Antenna Towers and Antenna Structures (4) Bleachers and grandstands per 35.9.1.6 **35.9.1.5** No part (component, cladding, or fastener) of a building or structure shall be designed for a wind load of less than 10 psf (0.48 kN/m2). **35.9.1.6** Grandstands and bleachers **35.9.1.6.1** Uplift wind pressures **35.9.1.6.2** vertically on closed-deck grandstand	
SECTION 1616A . DEFINITIONS	**ASCE 7 Section 6.2**	Minor amendments required
SECTION 1617A . SYMBOLS AND NOTATIONS	**ASCE 7 Section 6.3**	NFPA 5000/ASCE 7 requirements much more comprehensive.
SECTION 1618A . BASIC WIND SPEED	**35.9.2 Basic Wind Speed**. The basic wind speed determined in accordance with Section 6.5.4 of ASCE 7.	
SECTION 1619A . EXPOSURE *Exposure C is default requirement unless additional data provided*	**35.9.3* Exposure Category. E**xposure category determined using Section 6.5.6 of ASCE 7. **35.9.4** Occupancy Category and Wind Importance Factor. **35.9.4.1** Buildings and other structures shall be assigned an occupancy category in accordance with Table 35.3 to determine the wind load importance factor. 35.9.4.2* Buildings and other structures shall be assigned a wind load importance	Amendment required NFPA 5000/ASCE 7 requirements much more comprehensive.

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	factor (I) in accordance with Section 6.5.5 of ASCE 7.	
SECTION 1620A . DESIGN WIND PRESSURES *Includes provisions story drift due to wind*	ASCE 7 Section 6.4 (Simplified Procedure) or 6.5 (Analytical; Procedure)	Amendment required for drift NFPA 5000/ASCE 7 requirements much more complex.
SECTION 1621A . PRIMARY FRAMES AND SYSTEMS	ASCE 7 Section 6.4 (Simplified Procedure) or 6.5 (Analytical; Procedure)	Amendment required for uplift NFPA 5000/ASCE 7 requirements much more complex.
SECTION 1622A . ELEMENTS AND COMPONENTS OF STRUCTURES	ASCE 7 Section 6.4 (Simplified Procedure) or 6.5 (Analytical; Procedure)	NFPA 5000/ASCE 7 requirements much more complex.
SECTION 1623A . OPEN-FRAME TOWERS	ASCE 7 Section 6.5 (Analytical; Procedure)	NFPA 5000/ASCE 7 requirements much more complex.
SECTION 1624A . MISCELLANEOUS STRUCTURES	ASCE 7 Section 6.4 (Simplified Procedure) or 6.5 (Analytical; Procedure)	NFPA 5000/ASCE 7 requirements much more complex.
SECTION 1625A . OCCUPANCY CATEGORIES	ASCE 7 Section 6.5.5	
Division IV.EARTHQUAKE DESIGN **SECTION 1626A . GENERAL** **1626A.2 Minimum Seismic Design.** **1626A.3 Seismic andWind Design.** ***1626A.4 [For OSHPD 1 & 4] Configuration***	35.10 Earthquake Loads. Section 9 of ASCE 7.	Amendments required for minimum seismic design, configuration, additions and alterations.
SECTION 1627A . DEFINITIONS	ASCE 7 Section 9.2 NFPA 5000 reproduces some of the definitions found in ASCE 7.	Extensive amendments required to cover additions, repairs and alterations
SECTION 1628A . SYMBOLS AND NOTATIONS	ASCE 7 Section 9.2.2 NFPA 5000 reproduces two notations found in ASCE 7.	
SECTION 1629A . CRITERIA SELECTION **1629A.1 Basis for Design.**	ASCE 7 Section 9.1	Amendments required to remove conflicting language on additions, alterations, and retrofits
1629A.2 Occupancy Categories.	ASCE 7 Section 9.1	Fundamental change in approach. Seismic design requirements now based on Seismic Design Category (SDC) that is a function of occupancy and seismic risk. Amendments required.
1629A.3 Site Geology and Soil Characteristics. **1629A.4 Site Seismic Hazard Characteristics.** **1629A.4.1 Seismic zone.** **1629A.4.2 Seismic Zone 4 near-source factor** **1629A.4.3 Seismic response coefficients.**.	ASCE 7 Section 9.4.1.2.2, 9.4.1.2.3 ASCE 7 Section 9.4.1.2.1 ASCE 7 Section 9.4.1.2.4	Zone maps have been replaced by contour maps. Seismic demand is different. There are no near source factors
1629A.5 Configuration Requirements. **1629A.5.1 General** **1629A.5.2 Regular structures.** **1629A.5.3 Irregular structures.**	ASCE 7 Section 9.5.2.3	Similar provisions to 2001 CBC. Some amendments required
1629A.6 Structural Systems. **1629A.6.1 General.** **1629A.6.2 Bearing wall system.** **1629A.6.3 Building frame system.** **1629A.6.4 Moment-resisting frame system.** **1629A.6.5 Dual system.** **1629A.6.6 Cantilevered column system.** **1629A.6.7 Undefined structural system**. **1629A.6.8 Nonbuilding structural system.** **1629A.7 Height Limits**	ASCE 7 Section 9.5.2.1 ASCE 7 Section 9.5.2.2	Extensive amendments required. ASCE 7 permits widespread use of very low ductility lateral force resisting systems.
1629A.8 Selection of Lateral-force Procedure. **1629A.8.1 General.** **1629A.8.2 Simplified static.** *[Not adopted by OSHPD.]*	ASCE 7 Section 9.5.2.5 ASCE 7 Section 9.5.2.5.1	Extensive amendments required. ASCE 7 permits index and simplified lateral force design procedures. ASCE 7 permits 6 analytical methods: 1. Index force analysis

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1629A.8.3 Static. **1629A.8.4 Dynamic.**		2. Simplified analysis 3. Equivalent lateral force analysis 4. Modal response spectrum analysis 5. Linear response history analysis 6. Nonlinear response history analysis
1629A.9 System Limitations **1629A.9.1 Discontinuity**	ASCE 7 Section 9.5.2.6.2.4	
1629A.9.2 Undefined structural systems	ASCE 7 Section 9.5.2.2	Amendment required
1629A.9.3 Irregular features	ASCE 7 Section 9.5.2.3	Significant amendments required
SECTION 1630A . MINIMUM DESIGN LATERAL FORCES AND RELATED EFFECTS **1630A.1 Earthquake Loads and Modeling Requirements.** **1630A.1.1 Earthquake loads.** Redundancy Factor Seismic dead load	ASCE 7 Section 9.5.2.5 ASCE 7 Section 9.5.2.7.1 ASCE 7 Section 9.5.2.4 ASCE 7 Section 9.5.3	Amendments required. ASCE 7 links design and detailing requirements to SDC rather than importance or occupancy Weight definition must be moved out of the index force provisions. Amendment for unbalanced soil loads required.
1630A.1.2 Modeling requirements. **1630A.1.3 *PΔ*. effects.** **1630A.2 Static Force Procedure.** **1630A.2.1 Design base shear.** **1630A.2.2 Structure period.** **1630A.2.3 Simplified design base shear.** *[Not adopted by OSHPD]* **1630A.2.3.1 General.** **1630A.2.3.2 Base shear.** **1630A.2.3.3 Vertical distribution.**. **1630A.2.3.4 Applicability.**	ASCE 7 Section 9.5.3 through 9.5.8 ASCE 7 Section 9.5.5.7 ASCE 7 Section 9.5.5 ASCE 7 Section 9.5.5.2 ASCE 7 Section 9.5.5.3 ASCE 7 Section 9.5.4	Extensive amendments required. Modeling requirements vary depending on the analysis procedure chosen. Amendments may be required Amendments required Not adopted by OSHPD
1630A.3 Determination of Seismic Factors. **1630A.3.1 Determination of Ω*o*.** **1630A.3.2 Determination of *R*.**	ASCE 7 Section 9.5.2.2	Extensive amendments required. ASCE 7 permits widespread use of very low ductility lateral force resisting systems.
1630A.4 Combinations of Structural Systems. **1630A.4.1 General.** **1630A.4.2 Vertical combinations.** **1630A.4.3 Combinations along different axes.** **1630A.4.4 Combinations along the same axis.**	ASCE 7 Section 9.5.2.2	Amendments required
1630A.5 Vertical Distribution of Force.. **1630A.7 Horizontal Torsional Moments.**	ASCE 7 Section 9.5.5.4 ASCE 7 Section 9.5.5.	Requirements similar
1630A.8 Overturning. **1630A.8.1 General.**	ASCE 7 Section 9.5.5.6	Amendments required
1630A.8.2 Elements supporting discontinuous systems. **1630A.8.2.1 General** **1630A.8.2.2 Detailing requirements in Seismic Zones 3 and 4**	 ASCE 7 Section 9.5.2.6.2.11 ASCE 7 Section 9.5.2.6.4.2 ASCE 7 Section 9.5.2.6.5.1	Amendments required. Varies with SDC
1630A.8.3 At foundation.	No requirements	Amendment required
1630A.9 Drift.	ASCE 7 Section 9.5.2.8 ASCE 7 Section 9.5.5.7	Varies with analysis method
1630A.9.1 Determination of Δ*S*.	ASCE 7 Section 9.5.5.7.1	
1630A.9.2 Determination of Δ*M*	ASCE 7 Section 9.5.5.7.1 ASCE 7 Section 9.5.6.6	

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1630A.10 Story Drift Limitation.	ASCE 7 Section 9.5.2.8 ASCE 7 Section 9.5.4.4 ASCE 7 Section 9.5.6.6 ASCE 7 Section 9.5.8.3	Amendment required. Permissible drifts depend on analysis method
1630A.10.1 General.	ASCE 7 Section 9.5.5.7	
1630A.10.2 Calculated.		
1630A.10.3 Limitations.		
1630A.11 Vertical Component.	ASCE 7 Section 9.5.2.6.4.3	
SECTION 1631A . DYNAMIC ANALYSIS PROCEDURES **1631A.1 General.**	ASCE 7 Section 9.5.6	Dynamic procedures cover only the modal analysis. Other requirements (ground motion, detail requirements) not tied to procedure
1631A.2 Ground Motion.	ASCE 7 Section 9.4.1.2.6	May require amendment
1631A.3 Mathematical Model.	ASCE 7 Section 9.5.6.2	
1631A.4 Description of Analysis Procedures.		
1631A.4.1 Response spectrum analysis.		
1631A.4.2 Time-history analysis.	ASCE 7 9.5.8	Amendment required. ASCE 7 permits nonlinear response history analysis
1631A.5 Response Spectrum Analysis.	ASCE 7 Section 9.5.6	
1631A.5.1 Response spectrum representation and interpretation of results.	ASCE 7 Section 9.5.6. ASCE 7 Section 9.5.6.7	
1631A.5.2 Number of modes.	ASCE 7 Section 9.5.6.3	
1631A.5.3 Combining modes.	ASCE 7 Section 9.5.6.6	
1631A.5.4 Reduction of Elastic Response Parameters for design.	ASCE 7 Section 9.5.6.5	Amendment may be required
1631A.5.5 Directional effects.	ASCE 7 Section 9.5.2.5.2 ASCE 7 Section 9.5.2.6.2.4	Amendment may be required. Requirements vary with SDC
1631A.5.6 Torsion.	ASCE 7 Section 9.5.5.4	Amendment may be required
1631A.5.7 Dual systems.	ASCE 7 Section 9.5.2.2.1	Amendment required
1631A.6 Time-history Analysis. **1632A.1 General.**	ASCE 7 Section 9.5.7	Detailed review needed
1631A.6.1 Time history.	ASCE 7 Section 9.5.7.2	
1631A.6.2 Elastic time-history analysis.	ASCE 7 Section 9.5.7.2 ASCE 7 Section 9.5.7.3	
1631A.6.3 Nonlinear time-history analysis.	ASCE 7 Section 9.5.8	Extensive review needed. Amendments likely to be required
1631A.6.3.1 Nonlinear time history.	ASCE 7 Section 9.5.8	
1631A.6.3.2 Design review. *[Not adopted by OSHPD]*	ASCE 7 Section 9.5.8.4	Amendment required
SECTION 1632A . LATERAL FORCE ON ELEMENTS OF STRUCTURES, NONSTRUCTURAL COMPONENTS AND EQUIPMENT SUPPORTED BY STRUCTURES	ASCE 7 Section 9.6	Significantly more detail in ASCE 7. Extensive coverage of architectural elements including glazing and curtain walls. Some amendments required for OSHPD performance objectives
1632A.1 General.	ASCE 7 Section 9.6.1	
1632A.2 Design for Total Lateral Force.	ASCE 7 Section 9.6.1.3	
1632A.3 Specifying Lateral Forces.	ASCE 7 Section 9.6.1	
1632A.4 Relative Motion of Equipment Attachments.	ASCE 7 Section 9.6.1.4	
1632A.5 Alternative Designs.	ASCE 7 Section 9.6.3.15	Some amendments required
1632A.6 HVAC Ductwork, Plumbing/Piping and Conduit Systems.	ASCE 7 Section 9.6.3	Some amendments required
SECTION 1633A . DETAILED SYSTEMS DESIGN REQUIREMENTS **1633A.1 General.**	ASCE 7 Section 9.5.2.2.4.3 ASCE 7 Section 9.5.2.6	
1633A.2 Structural Framing Systems. **1633A.2.1 General.**	ASCE 7 Section 9.5.2.2	Amendments required
1633A.2.2 Detailing for combinations of systems.	ASCE 7 Section 9.5.2.2.2	Amendments required

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1633A.2.3 Connections		Amendments required
1633A.2.4 Deformation compatibility.	ASCE 7 Section 9.5.2.2.4.3	
1633A.2.4.1 Adjoining rigid elements.	ASCE 7 Section 9.5.2.2.4.2	
1633A.2.4.2 Exterior elements.	ASCE 7 Section 9.6.2.4	
1633A.2.5 Ties and continuity.	ASCE 7 Section 9.5.2.6.1.1	Amendments required. Varies with SDC
1633A.2.6 Collector elements.	ASCE 7 Section 9.5.2.6.2.6 ASCE 7 Section 9.5.2.6.3.1 ASCE 7 Section 9.5.2.6.4.1	Amendments required. Varies with SDC
1633A.2.7 Concrete frames.	ASCE 7 Table 9.5.2.2	Amendments required. Varies with SDC
1633A.2.8 Anchorage of concrete or masonry walls.	ASCE 7 Section 9.5.2.6.1.2 ASCE 7 Section 9.5.2.6.2.8 ASCE 7 Section 9.5.2.6.3.2	Amendments required. Varies with SDC
1633A.2.8.1 Out-of-plane wall anchorage to flexible diaphragms	ASCE 7 Section 9.5.2.6.3.2	Amendments required. Varies with SDC
1633A.2.9 Diaphragms.	ASCE 7 Section 9.5.2.6.2.7 ASCE 7 Section 9.5.2.6.4.4	Amendments required. Varies with SDC
1633A.2.10 Framing below the base.	ASCE 7 Section 9.5.7	Amendments required
1633A.2.11 Building separations.	ASCE 7 Section 9.5.2.8	Amendments required
1633A.2.12 Foundations and superstructure-to-foundation connections.	ASCE 7 Section 9.5.7	Amendments required. Varies with SDC
1633A.2.13 Requirements for elevators.	ASCE 7 Section 9.6.3.16	Amendments required
SECTION 1634A . NONBUILDING STRUCTURES	ASCE 7 Section 9.14	ASCE 7 provisions far more extensive. Detailed review and some amendments required
SECTION 1635A . EARTHQUAKE-RECORDING INSTRUMENTATIONS		Amendments required
Division V. SOIL PROFILE TYPES SECTION 1636A . SITE CATEGORIZATION PROCEDURE	ASCE 7 Section 9.4.1.2	
1636A.1 Scope.	ASCE 7 Section 9.4.1.2	
1636A.2 Definitions	ASCE 7 Section 9.4.1.2.1	
1636A.2.1 Average shear wave velocity.	ASCE 7 Section 9.4.1.2.2.2	
1636A.2.2 average field standard penetration resistance and average standard penetration resistance for cohesionless soil layers.	ASCE 7 Section 9.4.1.2.3	
1636A.2.3 Average undrained shear strength.	ASCE 7 Section 9.4.1.2.3	
1636A.2.4 Soft clay profile,	ASCE 7 Section 9.4.1.2.2	
1636A.2.5 Soil profiles	ASCE 7 Section 9.4.1.2.2	
1636A.2.6 Rock profiles	ASCE 7 Section 9.4.1.2.2	
SECTION 1637A . SITE DATA FOR STATE-OWNED OR STATE-LEASED ESSENTIAL SERVICES		Amendments required
SECTION 1638A [FOR OSHPD 1 & 4] . ADDITIONS, ALTERATIONS, REPAIRS AND SEISMIC RETROFIT TO EXISTING BUILDINGS OR STRUCTURES	NFPA 5000 Chapter 15	Extensive amendments required. Conflicts with statutory and regulatory requirements
Division VI-R .EARTHQUAKE EVALUATION AND DESIGN FOR RETROFIT OF [FOR BSC, DSA] EXISTING STATE-OWNED BUILDINGS [FOR OSHPD] EXISTING HOSPITAL BUILDINGS		No corresponding provisions.
	NFPA Section 35.4	Requirements for construction documents. Corresponds to requirements in the Administrative Code. Amendments

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		required.